HAMAMATSU

PHOTON IS OUR BUSINESS

Direct Diode Laser

Direct Diode Laser (DDL) is laser oscillators designed to condense light beams emitted from the LD stack module and directly irradiate them onto a target object. Compared to solid-state lasers and CO_2 lasers, Direct Diode Laser are very compact and feature low power consumption.

Features

- High-grade processing
- Ease of operation
- Low power consumption
- High efficiency
- Idle-free operation
- Compact size and light weight

Applications

- Metal processing
- Welding, tailored blanks, brazing, hardening, etc.
- Heat treatment
- Marking, etc.

HAMAMATSU PHOTONICS K.K.

Direct Diode Laser

■Direct diode laser（DDL）L11585-02/-04

The L11585-02 and L11585-04 are Direct Diode Laser (DDL) that condense light beams emitted from the internal LD stack module and directly irradiate them onto a target object. Compared to solid-state lasers and CO_2 lasers, these DDL do not require complicated light-transmission optical systems and feature compact dimensions and low power consumption. Their condensed light spot is rectangular and has an energy density optimized for laser processing-machining applications for high-grade laser processing with less spatter. Applications include laser welding, hardening, brazing, and heat treatment.

General specifications

Parameter	Value	Unit
Operation mode	CW	—
Lens	f = 100	mm
Humidity inside DDL	30	%
Operating temperature *1	+5 to +40	°C
Storage temperature *1*2*3 (Recommendation)	0 to +50 (+5 to +35)	°C
Dimensions (W × H × D) *4	Approx. 165 × 160 × 414 (not including projecting parts)	mm

*1 No condensation
*2 Drain the water from DDL if there is a risk of freezing.
*3 Storage temperature is the temperature range for storing or transporting a DDL after installing it into equipment. Values in parentheses indicate the recommended temperature range for storing a DDL before installing it into equipment.
*4 Dimensions and weight may change depending on the attached options.

Recommended operating conditions

Parameter		Value	Unit
Cooling water conditions (at cooling water inlet)	Conductivity	1.0	μS/cm
	Temperature	+20	°C
Dry air conditions *1	Flow rate	1.5	L/min
	Temperature	+25	°C

*1 When using compressed air containing oil mist (oil mist concentration of 30 mg/m³ [ANR] or more), a prefilter must be used to remove the oil content. If moisture might possibly contaminate the supply piping, a water separator must be used to remove water droplets. Constantly inject dry air into the DDL, regardless of whether it is operated or not (stored) except during shipping.

Specifications

●L11585-02

Cooling water flow rate: Approx. 10 L/min, Cooling water temperature (at inlet of DDL): 20.0 °C ± 0.5 °C

Parameter		Conditions	Typical value	Unit
Operating current		Radiant power: 2.0 kW	80	A
Operating voltage			46	V
Peak emission wevelength			940	nm
Beam focus diameter *1 (FWHM)	Vertical direction *2		0.35	mm
	Horizontal direction *2		1.25	mm
Working distance (design value from housing tip)			87.0	mm
Weight (excluding cooling water)			12	kg

●L11585-04

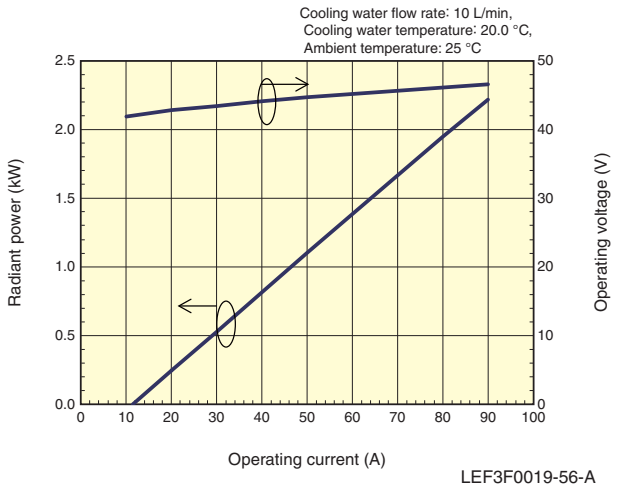
Cooling water flow rate: Approx. 22 L/min, Cooling water temperature (at inlet of DDL): 20.0 °C ± 0.5 °C

Parameter		Conditions	Typical value	Unit
Operating current		Radiant power: 4.0 kW	88	A
Operating voltage			94	V
Peak emission wevelength			940	nm
Beam focus diameter *1 (FWHM)	Vertical direction *2		0.35	mm
	Horizontal direction *2		1.25	mm
Working distance (design value from housing tip)			87.0	mm
Weight (excluding cooling water)			13	kg

*1 Beam profile area is within ±15 % of typical value (0.35 mm x 1.25 mm = 0.44 mm²).
*2 Directions are relative to bottom of housing. The short axis of the condensed light spot is perpendicular to the bottom of housing. (See the schematic view of main laser beam and guide beam (not visible) directions.)
The condensed light spot size can be changed by replacing the condenser lens and condenser lens unit at the DDL tip.

Characteristic example

●L11585-02



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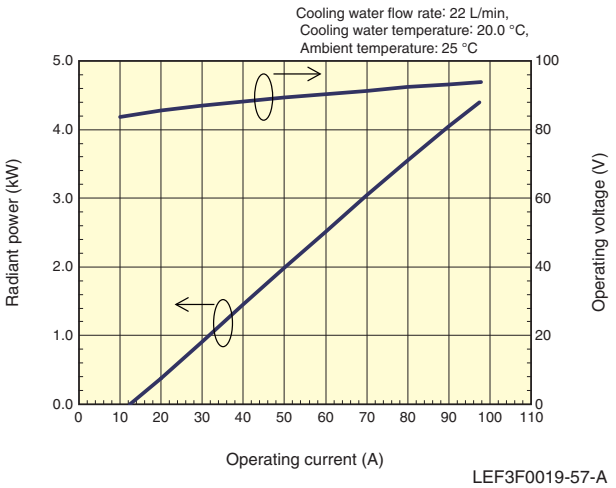
●L11585-04



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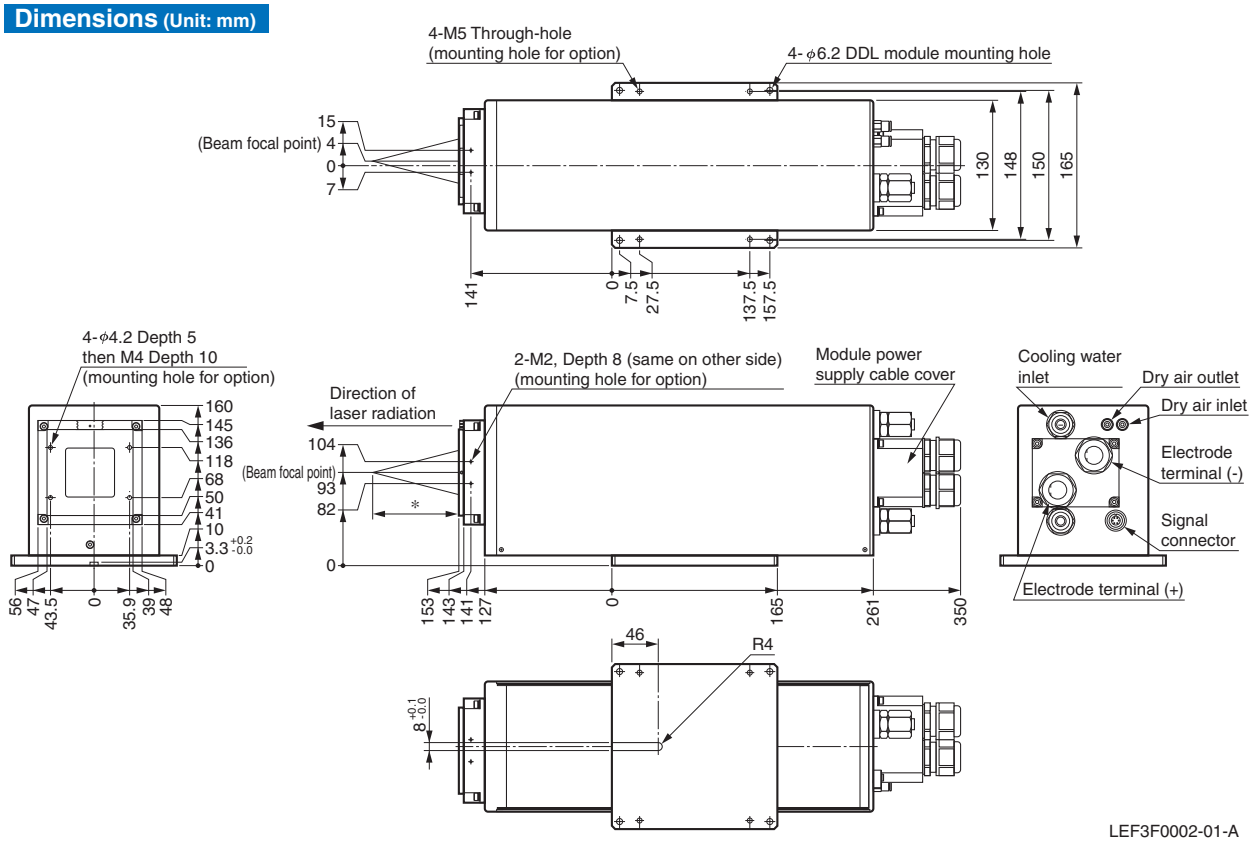
Dimensions (Unit: mm)



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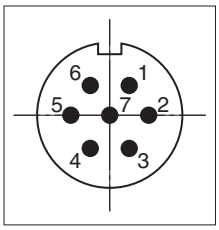
Signal connector pinout

Pin No.	I/O	Name
1	Input	Sensor power (+)
2	Input	Sensor power (-)
3	Output	Humidity sensor
4	Output	Water leakage sensor signal
5	Output	Water leakage sensor Level 1
6	Output	Water leakage sensor Level 2
7	—	FG



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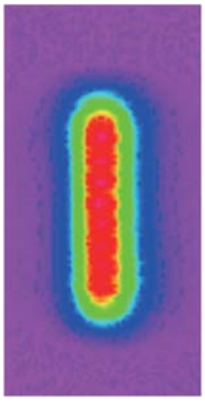
Beam focus pattern (Example: 2 kW radiant power)



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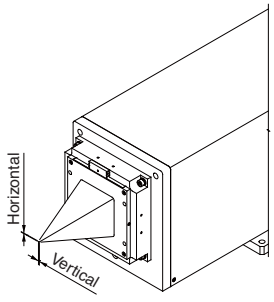
Schematic view of main laser beam and guide beam (not visible) directions



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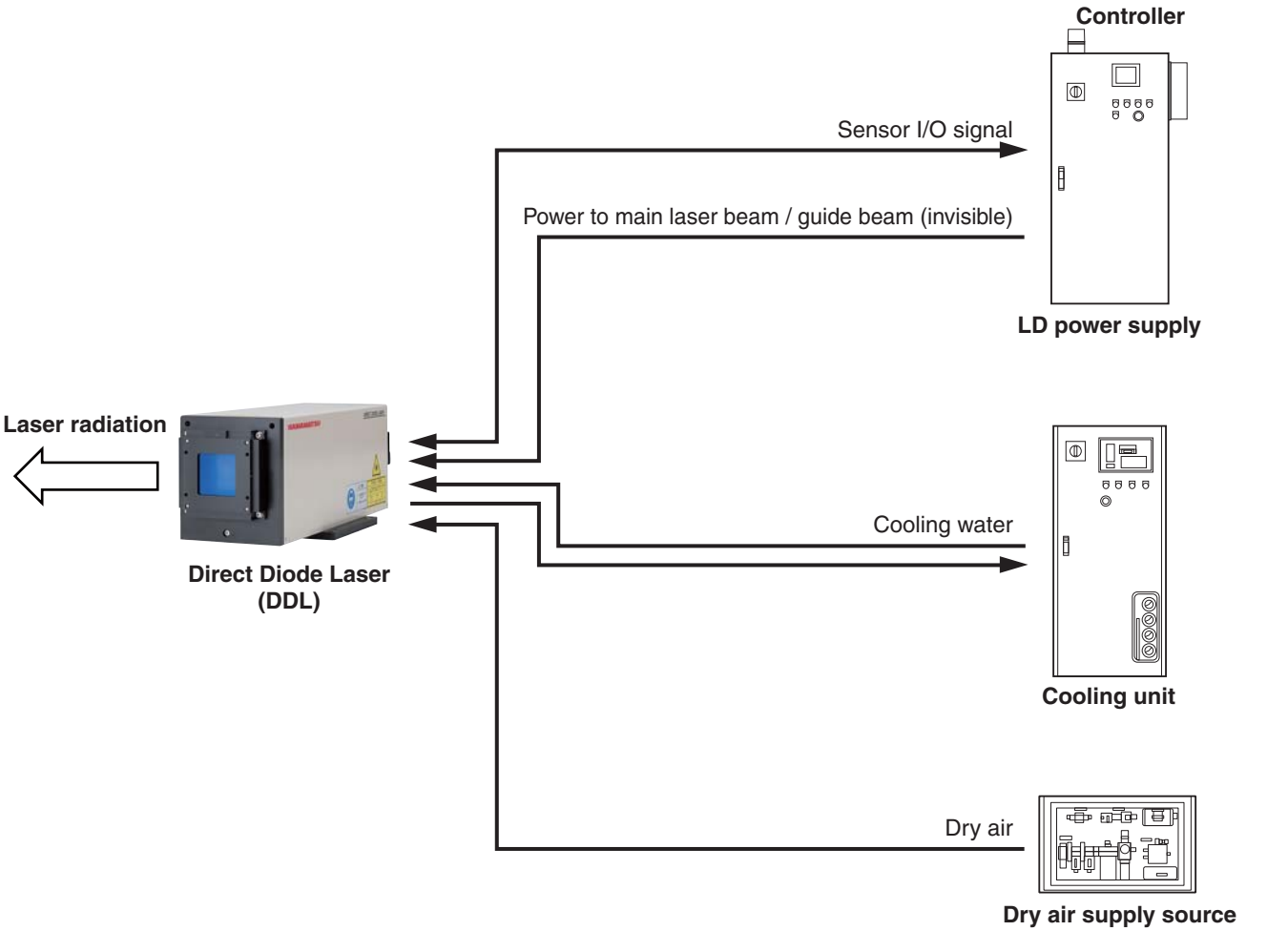
Connection example



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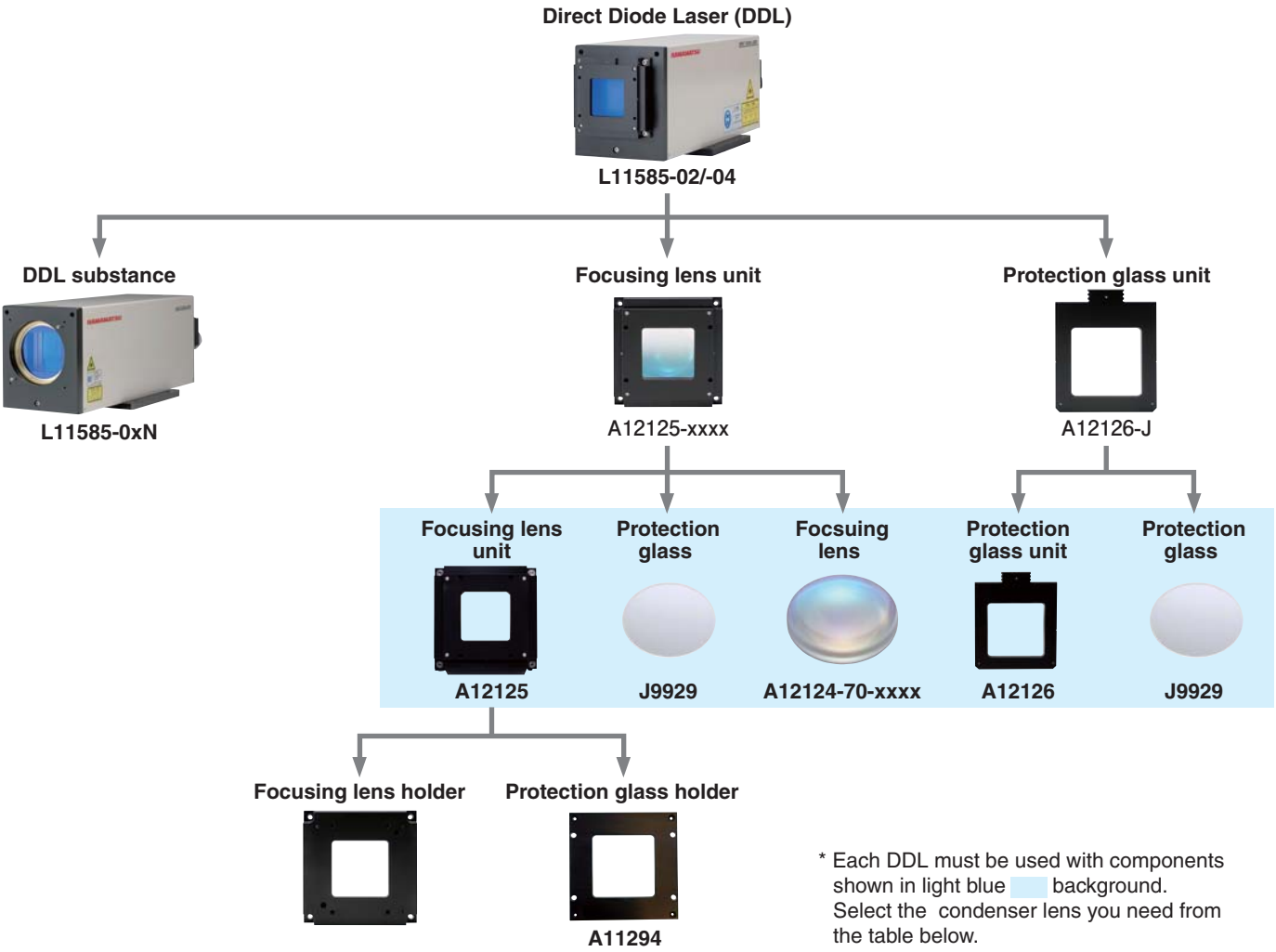
* Install an interlock function that cuts off power to the DDL if cooling water supply to DDL stops or falls below the specified flow rate.
* Please make contact with Hamamatsu salses office about recommended LD power supplies and recommended cooling unit .

Introduction for Direct Diode Laser (DDL)



* Each DDL must be used with components shown in light blue background. Select the condenser lens you need from the table below.

●Focusing lens unit

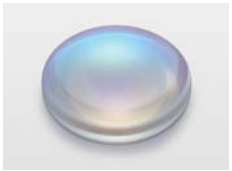
Type No.	Dimensions (W × H × D)
A12125 *1	Approx. 104 mm × 104 mm × 26 mm
A12125-0380 *2	

*1 Please order separately the protection glass J9929 and the focusing unit A12124 series.
*2 A12125-0380 incorporates a special protection glass J9929 and focusing lens A12124-70-0380 into A12125.

●Protection glass

Type No.	Dimensions (D × t)
J9929	ϕ70 mm × 1 mm

●Focusing lens



Type No.	Working distance*3 @940 nm	Beam focus diameter	Maximum input light power	Dimensions (D × L)
A12124-70-0100	Approx. 87 mm	1.3 mm × 0.4 mm	6 kW	Approx. ϕ70 mm × 16 mm
A12124-70-0130	Approx. 117 mm	1.55 mm × 0.45 mm		Approx. ϕ70 mm × 13 mm
A12124-70-0150	Approx. 138 mm	1.8 mm × 0.5 mm		Approx. ϕ70 mm × 12 mm
A12124-70-0200	Approx. 190 mm	2.35 mm × 0.65 mm		Approx. ϕ70 mm × 9.5 mm
A12124-70-0380	Approx. 369 mm	4.4 mm × 1.2 mm		Approx. ϕ70 mm × 6 mm

*3 When mounted in L11585 series

●Protection glass unit

Type No.	Dimensions (W × H × D)
A12126 *4	Approx. 72 mm × 88 mm × 4 mm
A12126-J *5	

*4 Please order separately the protection glass J9929.
*5 A12126-J incorporates a special protection glass J9929 in A12126.

Reference information

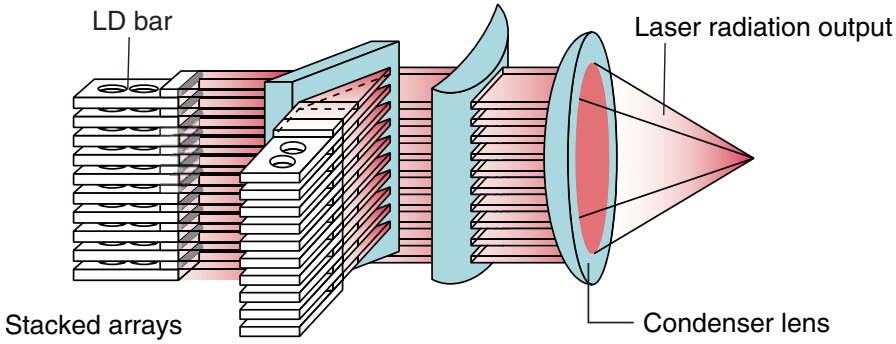
Semiconductor laser for machining or processing

Direct Diode Laser(DDL) is one of laser oscillators that condense the laser beams emitted from an Laser Diode(called LD) stack module comprised of semiconductor laser arrays by using a prism and lenses, and produce a high-density light spot optimized for laser beam machining or processing.
Laser beams from the LD stack module are concentrated by optical synthesis through a stripe mirror and edge filter or through polarization and wavelength combination, and are shaped by multiple lenses into beam patterns ideal for laser beam machining or processing.

Besides DDL there are laser oscillators using semiconductor lasers such as a fiber-output LD bar module (called FOLD). The FOLD module offers the advantage of minimal beam variations between individual units since the laser beams emitted from the semiconductor laser arrays are guided into an optical fiber. However, compared to DDL, the light concersion efficiency (output power versus input power) is low, due to coupling loss and transmission loss that occur when the laser beams enter and transmit through the optical fiber.

Although DDL uses a simple optical system to utilize light with high efficiency, the condensed light spot is likely to vary between individual units. To cope with this problem, Hamamatsu also provides the A14132 series irradiation unit (beam homogenizer) specifically designed for DDL to minimize beam variations between individual units while still utilizing laser light with the high efficiency needed for laser beam machining or processing.

●Structure of DDL

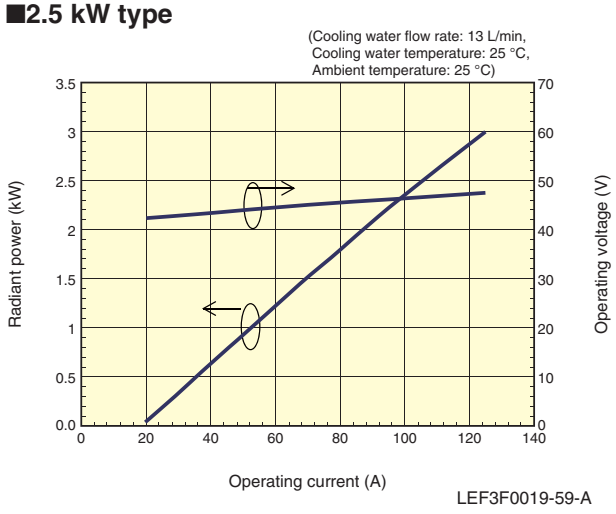


Reference information

High output power technology

We are developing a higher output type of L11585 series Direct Diode Laser (DDL).

■2.5 kW type



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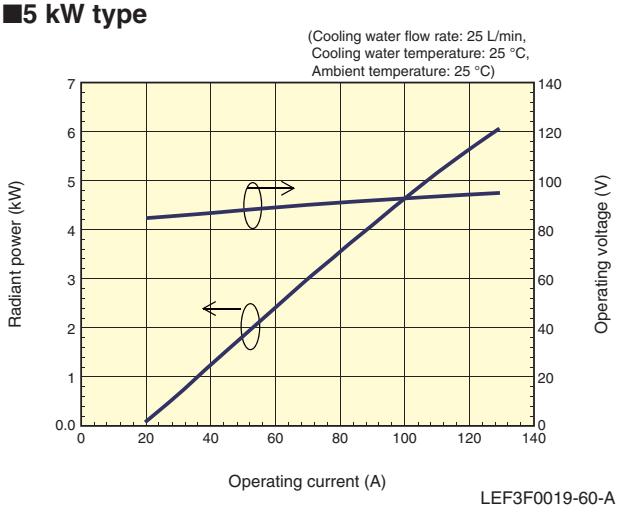
■5 kW type



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Irradiation unit (beam shaping type)

■Irradiation unit (beam shaping type) A14132-BD

When mounted onto a Hamamatsu Direct Diode Laser (DDL) L11585 series, the Irradiation unit (beam shaping type) a uniform beam pattern ideal for laser quenching and thermal treatment. The A14132 includes an aspect ratio conversion unit and laser focusing unit which can be selected to change the different aspect ratios to adjust the laser irradiation area. A thermometer can be attached by installing an optional coaxial unit, allowing coaxial measurement of the processing point temperature. A coaxial camera and visible pointer can also be added.

Specifications

Parameter	L11585-02	L11585-04	Unit
Maximum light radiant output power	1.8	2.5	kW
Radiant light output power (Typ.)	1.6	2.0	kW
Dimensions (W × H × D)	Approx. 116 × 116 × 292 (excluding protuberance)		mm
Beam spot size	5 × 10		mm
Weight	Approx. 3		kg
Oscillation mode	CW		—

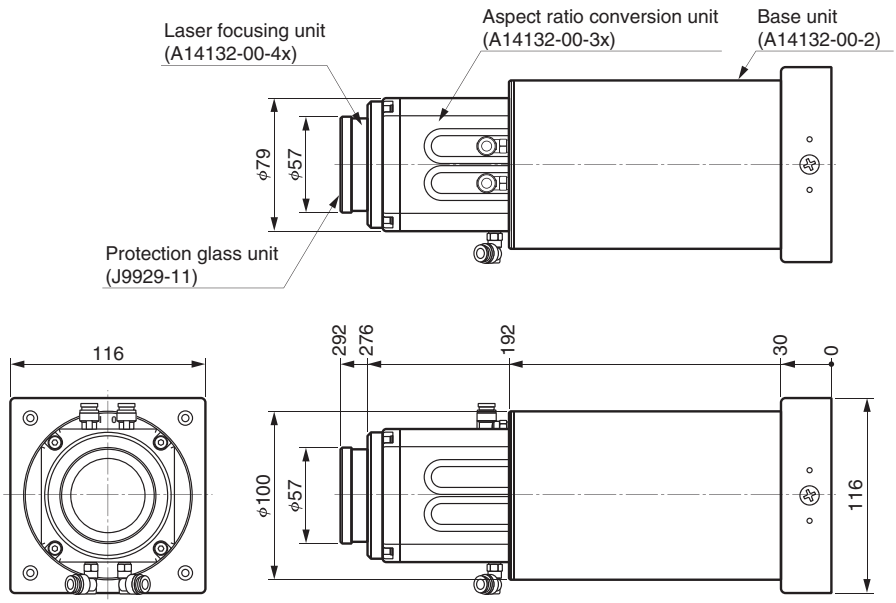
* When attached applicable products.
* The working distance and condensed beam size can be changed as needed by replacing the aspect ratio converter unit and condenser lens unit.

Cooling water conditions

Parameter	Value	Unit
Conductivity	1.0	μS/cm
Temperature	+15 to +30	°C
Flow rate	1.0	L/mim.
Adapt cooling water hose *1	Outer diameter Approx. ϕ6	mm
	Inner diameter Approx. ϕ4	mm

*1 Besides deionized water and pure water, tap water can be used.

Dimensional (unit: mm)



* Tolerance is by JIS B 0405-m (Intermediate) unless specified.

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Irradiation unit (beam shaping type) A14132 series configuration selection examples

Irradiation unit (beam shaping type)

Base unit	Aspect ratio conversion unit	Laser focusing unit	Protection glass
			
A14132-00-2	A14132-00-3A A14132-00-3B A14132-00-3C A14132-00-3D A14132-00-3E	A14132-00-4A A14132-00-4B A14132-00-4C A14132-00-4D	J9929-11

A14132 - B D

A14132 - B D

- Aspect ratio conversion unit: A14132-00-3A | 1:2
- Laser focusing unit: A14132-00-4A | F200

●Base unit

Type No.	Dimensions (W × H × D)
A14132-00-2	Approx. 116 mm × 116 mm × 276 mm

●Aspect ratio conversion unit

Type No.	Aspect ratio	Working distance*1 @940 nm	Beam spot size @940 nm *1	Incident maximum light output power	Dimensions (W × H × D)
A14132-00-3A	1:1	Approx. 193 mm	5.0 mm × 5.0 mm	3 kW	Approx. 79 mm × 79 mm × 20 mm
A14132-00-3B	1:2		5.0 mm × 10.0 mm		
A14132-00-3C	1:3		5.0 mm × 15.0 mm		
A14132-00-3D	1:4		5.0 mm × 20.0 mm		
A14132-00-3E	1:5		5.0 mm × 25.0 mm		

*1 A14132-00-4D (F200) is used

●Laser focusing unit

Type No.	Focal length	Working distance*2 @940 nm	Beam spot size @940 nm *2	Incident maximum light output power	Dimensions (ϕ× D)
A14132-00-4A	F100	Approx. 89 mm	2.5 mm × 5.0 mm	3 kW	Approx. ϕ55 mm × 13 mm
A14132-00-4B	F120	Approx. 110 mm	3.0 mm × 6.0 mm		
A14132-00-4C	F160	Approx. 151 mm	4.0 mm × 8.0 mm		
A14132-00-4D	F200	Approx. 193 mm	5.0 mm × 10.0 mm		

*2 A14132-00-3B (1:2) is used

●Protection glass


With holder


No holder

Type No.	Dimensions (ϕ× t)
J9929-11 *3	ϕ57 mm × 6.5 mm
J9929-05	ϕ50 mm × 1 mm

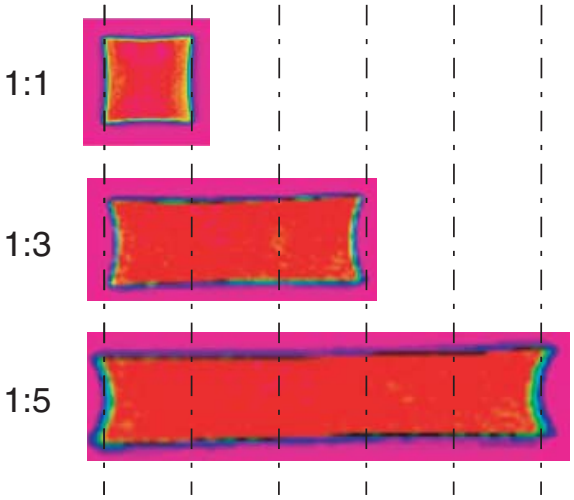
*3 With holder

Irradiation unit (beam shaping type) A14132 series configuration selection examples

Beam size lineup by model number combination

Aspect ratio			Laser focusing unit			
			A	B	C	D
			F100	F120	F160	F200
Aspect ratio conversion unit	A	1:1	2.5 mm × 2.5 mm	3.0 mm × 3.0 mm	4.0 mm × 4.0 mm	5.0 mm × 5.0 mm
	B	1:2	2.5 mm × 5.0 mm	3.0 mm × 6.0 mm	4.0 mm × 8.0 mm	5.0 mm × 10.0 mm
	C	1:3	2.5 mm × 7.5 mm	3.0 mm × 9.0 mm	4.0 mm × 12.0 mm	5.0 mm × 15.0 mm
	D	1:4	2.5 mm × 10.0 mm	3.0 mm × 12.0 mm	4.0 mm × 16.0 mm	5.0 mm × 20.0 mm
	E	1:5	2.5 mm × 12.5 mm	3.0 mm × 15.0 mm	4.0 mm × 20.0 mm	5.0 mm × 25.0 mm

Example of beam pattern 2D image



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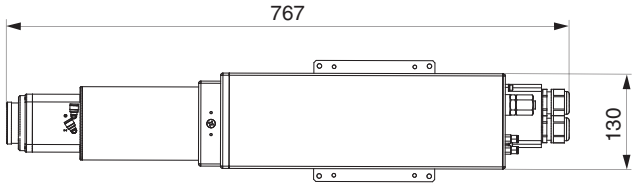
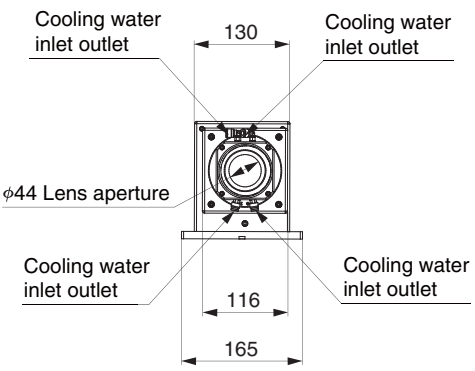
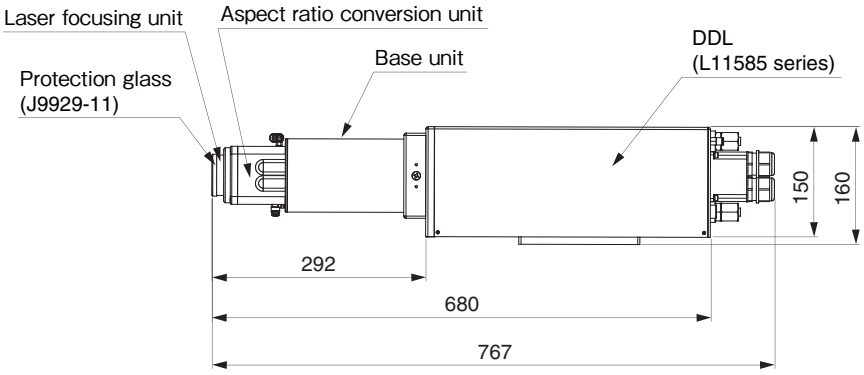
Example of mounting to DDL (Unit: mm)







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Example of customization

Reference information

Custom example of L11585 series

Hamamatsu provides custom optical systems specifically designed to attach to the L11585 series DDL. So please contact us if you have any inquiries about beam patterns, etc.

■Irradiation unit

■Example of mounting to DDL

Reference information

Custom example of beam shaping type DDL

Hamamatsu also offers custom DDL coupled to an A14132 series irradiation unit (beam homogenizer) and a coaxial unit that can be used for observation and temperature measurement of the laser beam machining point. So please contact us for any inquiries about custom made products.

■Example of mounting to DDL

Related products

■Applied products of semiconductor lasers

●LD irradiation light source SPOLD®
L13920-611 200 W type

●LD irradiation light source SPOLD®
L13920-711 360 W type

LD irradiation light source SPOLD® is a compact laser light source that combines a distilled water-cooled fiber-output laser diode module with its driver and controller circuit. It emits laser light with any desired beam diameter and profile by selecting the irradiation unit. Our product line-up also includes built-in process monitor types.

Be sure to read before using Direct Diode Lasers (DDL)

To ensure safe and efficient use of Direct Diode Lasers (DDL), thoroughly read the precautions and instructions for the product you purchased before attempting to use it.
Also carefully read the user's manual and precautions that come with the product and comply with those instructions and related laws and regulations.

⚠ Warning

●Caution points regarding laser radiation exposure

When using a laser product, check the laser product class as defined by IEC 60825-1 and take appropriate safety measures. Also comply with the related laws and regulations applicable in each country.

●Harmful substances

This product may contain substances harmful to the human body. These cause no problems during normal use. However, when disposing of these products, be sure to comply with the regulations enforced by the relevant local government.

●Safety measures

When using this product, take appropriate measures including designing safety features to avoid potential risks that might occur during normal use. The user must evaluate and install a safe laser system that complies with the regulations and standards in each country and the precautions needed for using the product.

●Safety precautions and instructions

- **This product is classified as a Class 4 laser product according to the laser product classification defined by IEC 60825-1. The main laser beam emitted from this product is non-visible light that cannot be seen by the human eye. Avoid eye and skin exposure to direct or scattered beams. To use this product safely, always comply with the safety precautions given in IEC 60825-01.**
- **We do not provide a guarantee of the system integrity and complete safety of this product. When this product is to be used in equipment or systems that might result in personal injury or death or damage to property if handled improperly, take appropriate measures including a design with ample safety features to avoid potential trouble that might occur during normal use.**

●Handling precautions

- **Mechanical shocks and vibrations may cause deterioration of DDL characteristics. Handle carefully to avoid applying shocks and vibrations to the DDL. To ensure good positioning repeatability when installing the DDL, do not use a knock pin or punch tool, but instead use a method that does not apply mechanical impacts to the DDL.**
- **To prevent damaging the DDL from light reflecting from the workpiece, be sure NOT to irradiate the beam perpendicular to the processed surface. (For detailed information, see the DDL instruction manual.)**
- **Dry air must be injected into the DDL during operation and during storage. After the DDL is delivered, start injecting dry air as quickly as possible. Failure to inject dry air into the DDL will cause a drop in performance characteristics. We recommend not even storing the DDL for a full day unless dry air is injected. If dry air cannot be injected into the DDL right away, we recommend storing it in a location where the temperature is maintained between +5 to +30 °C and at a relative humidity below 30 %.**
- **Failure to supply cooling water to the DDL will damage or destroy the internal LD module. Always supply cooling water during operation. Also be sure to use ion-exchanged water as the cooling water. We recommend exchanging the cooling water once every 6 months. Using poor quality water may destroy the LD in the DDL. (For detailed information, see the DDL instruction manual.)**

Safety measures for laser products

This product is a Class 4 laser product.
According to laser safety standards IEC 60825-1 which obligate manufacturers to provide preventive safety measures, Hamamatsu laser products are classified to implement appropriate safety measures and display required labels.
The user should also implement safety measures in compliance with applicable regulations in the relevant country.

Labels displayed (sample)

Explanatory label


Warning label

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